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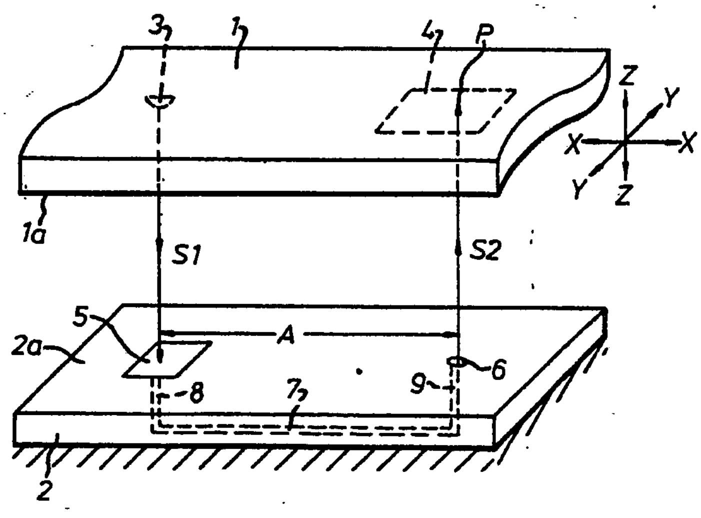
(54) Title: POSITIONING SYSTEM

(57) Abstract

A positioning system for detection and determination of a relative position between a first unit (1) arranged in a first plane and a second unit (2) arranged in a second plane parallel to said first plane and spaced therefrom. The units (1, 2) are mutually movable parallel to said planes, and the first unit (1) has a radiation source (3) for transmitting a beam of rays (S1) directed against the second unit (2), and a radiation detector (4) for detecting a beam of rays (S2) retransmitted from said second unit (2). The second unit (2) has a passive means (7) adapted, when said relative position lies within specific limits, to receive the beam of rays (S1) transmitted from said radiation source and to retransmit (S2) the radiation received towards said radiation detector (4). The system is characterized in that said passive means (7) has a separate radiation receiving portion (5) which is extended in said second plane and within which the transmitted beam of rays (S1) impinges when said relative position lies within said limits, and a separate radiation retransmitting portion (6) which is in optical communication with and, as seen in a direction parallel to said second plane, is spaced a distance (A) from said radiation receiving portion (5). The radiation detector (4) has a two-dimensionally position sensitive detection area, the beam of rays (S2) retransmitted from said radiation retransmitting portion having a convergence such that it impinges on a limited part (P) of the detection area, said radiation detector being further arranged such that it provides the position information which contains information about where (P) the retransmitted beam of rays (S2) impinges in the detection area.



POSITIONING SYSTEM

The present invention relates to a system for detection and determination of a relative position between a first unit arranged in a first plane and a second unit arranged in a second plane parallel to said first plane and spaced therefrom, said units being mutually movable parallel to said planes, and said first unit having a radiation source for transmitting a beam of rays directed against said second unit, and a radiation detector for detecting a beam of rays retransmitted from said second unit, said second unit having a passive means adapted, when said relative position lies within specific limits, to receive the beam of rays transmitted from said radiation source and to retransmit the radiation received towards said radiation detector which is adapted, in response to the retransmitted beam of rays, to provide position information corresponding to said relative position.

Positioning systems of this type may be used for example when one wishes to establish a desired position of a movable first unit relative to a stationary second unit, to detect that the desired position has been attained, or that this position lies within specific limits. In this connection, drive means for controlling the movable first unit preferably are adapted to receive the position information provided by said radiation detector in order to interrupt, in response to this information, the movement of said first unit when the desired position has been attained, or to direct said first unit towards a different position relative to said stationary second unit.

One field of application of such positioning systems is the positioning of automatically controlled trucks of the type which are caused to follow a path

or a loop on a factory floor or the like and which are stopped at predetermined positions or stations located along said path. It is especially important that the truck can be accurately positioned in relation to a given station if the truck supports a robot or the like whose movement pattern, when the truck has stopped at the station at issue, is dependent on a reference system which is stationary relative to the station or the floor. If the truck is positioned incorrectly by means of the above-mentioned positioning system at the station, the subsequent movements of the robot will be correspondingly incorrect.

Another application is the relative alignment of mutually movable machine components.

A third application is the alignment of a vehicle drawhook with a trailer or the like. In this instance, the source of radiation and the radiation detector preferably are mounted on the vehicle adjacent the drawhook thereof, the passive radiation receiving and retransmitting means being provided adjacent the trailer coupling member. When the driver has reversed the vehicle up against the trailer such that the drawhook takes up the correct position relative to the trailer coupling member, the said passive means receives radiation transmitted by the source of radiation and retransmits it to the radiation detector which, in response thereto, provides information to the driver that the vehicle is in correct position, whereupon the vehicle and the trailer can be coupled up.

Swedish Patent 366,127 discloses a system which is adapted to indicate a predetermined position between a first and a second object, said system being characterised in that the first object comprises a light transmitter and a light receiver with parallel optical axes, that the second object comprises a light

reflector which, when the predetermined position between the said two objects has been attained, is adapted to received light from the transmitter and to reflect said light in parallel with the received light towards the light receiver on the first unit, and that said light receiver is adapted to indicate the said predetermined position. The light reflector here is a so-called retroreflector, and the reflected light is transmitted from the reflector at substantially the same point where the reflector receives the corresponding light, which means that a turn of the reflector about an axis perpendicular to the main plane of said reflector does not affect the indication result. Like the present invention, this system thus comprises a source of radiation and a radiation detector on the first unit and a radiation receiving and retransmitting means on the second unit.

The system disclosed by Swedish Patent 366,127 is not, however, suited for the determination and detection of a relative position between a first unit arranged in a first plane and a second unit arranged in a second plane parallel to said first plane and spaced therefrom, which units are mutually movable in a direction of movement parallel to the said planes. More particularly, the system according to Swedish Patent 366,127 is arranged to detect a relative position between two objects approaching one another substantially in parallel with the optical axes of the radiation source and the radiation detector, whereas the present invention aims at solving the problems encountered when the two units are moving relative to one another in planes perpendicular to the said optical axes. Furthermore, the system according to the present invention provides possibilities of fine positioning, which is not the case with the system of Swedish Patent 366,127.

DE 2,617,797 discloses a system for optical measurement of a relative position between two units mutually movable in parallel planes, said first unit having a radiation source and a radiation detector, and said second unit having a passive means adapted to receive radiation transmitted from the radiation detector and to retransmit said radiation towards said radiation detector which is adapted, in response to the retransmitted radiation, to provide position information corresponding to said relative position. The radiation detector here consists of two photocells arranged closely adjacent one another, the position indicating information being calculated on the basis of how great a part of the retransmitted radiation impinges upon each of said photocells. The passive means consists of a reflective planar surface or a V-shaped prism, the base of which is facing said first unit.

The system disclosed by DE 2,617,797 thus merely permits position determination in one direction, which for instance in the positioning of automatically controlled trucks does not give sufficient accuracy, especially if the truck supports a robot or the like whose movements are calculated on the basis of a reference system which is stationary relative to the floor and which requires position determination in two dimensions in order to achieve adequate accuracy.

In the event that the passive means according to DE 2,617,797 is a planar reflective surface, a turn of the second unit about an axis perpendicular to said plane cannot be detected, and in the event that said passive means is a V-shaped prism, a turn of said second unit about said axis will cause the radiation retransmitted from said prism to fall outside the two photocells, such that there will be no position information even if the two units are close to one another.

A number of difficulties are encountered in the event that the positioning system of the type mentioned by way of introduction is used for interrupting the movement of a movable unit when this has been moved into such a position relative to a stationary unit that radiation is transmitted from said movable unit to said stationary unit and back to said stationary unit.

In the first place, the detection area of the system may be so large that satisfactory accuracy in the positioning of the first unit is obtained only within a limited part of the detection area. In the second place, the means provided for driving and controlling the movable unit may respond slowly to the position information given by the radiation detector, such that the movable unit is not stopped at the point where detection is obtained. In the third place, prior art positioning systems of the type here concerned offer no or but limited correction possibilities, in the event a position indication has been obtained, but an inccorrect relative position has been attained in response to this position indication. In the fourth place, most systems of this type offer no possibility of detecting whether the unit carrying the radiation receiving and retransmitting means is turned about an axis extending through said means in parallel with the path of rays, i.e. detecting relative turning of the units about the said axis.

The invention aims at solving the above-mentioned difficulties, and this is achieved if use is made of a positioning system of the type disclosed by way of introduction, said system being further characterised in that the passive means has a separate radiation receiving portion which is extended in said second plane and within which the transmitted beam of rays impinges when said relative position lies within said limits, and a separate radiation retransmitting por-

tion which is in optical communication with and, as seen in a direction parallel to said second plane, is spaced a distance from said radiation receiving portion; and that said radiation detector has a two-dimensionally position sensitive detection area, the beam of rays retransmitted from said radiation retransmitting portion having a convergence such that it impinges on a limited part of the detection area when said relative position lies within said limits, said radiation detector being further arranged such that the position information provided contains information about where the retransmitted beam of rays impinges in the two-dimensionally extended detection area.

The positioning system according to the invention thus comprises both a distance between the receiving location and the retransmitting location of the second unit and a distance between the radiation source and the radiation detector of the first unit and, furthermore, a detection area extended in two dimensions, for which reason the positioning and/or position determination of said first unit in relation to said second unit can be carried out on the one hand in two dimensions and, on the other hand, with far higher accuracy than is possible in prior art positioning systems. To be able to utilise the entire detection area of the radiation detector in the direction of movement, the extent of the receiving location in this direction is at least as large as the extent of the detection area in the same direction.

In an especially preferred embodiment of the invention, the radiation detector is a semiconductor detector which is position sensitive in one or two dimensions and has a detection area extended continuously in two dimensions in the first plane. (A semiconductor detector of this type, which is position sensitive in two dimensions, is commercially available under the tradename Sitek. A detailed description

of the function and construction of this detector is given in, for example, the publication "Elteknik med aktuell elektronik", 1983, No. 17, pp. 96 and 97.)

In another embodiment of the positioning system according to the invention, the radiation detector may comprise a plurality of separate radiation sensitive elements, such as photocells or the like, which are distributed in two dimensions, for example in parallel with the first plane. The fine positioning accuracy is, in this instance, directly dependent on the number or denseness of the radiation sensitive elements.

In an especially inexpensive, compact and simple variant of the invention, the passive means consists of at least one optical fibre, one end of which is attached at the receiving location and the other end at the retransmitting location on the second unit.

In a preferred embodiment of the invention, the radiation source and the radiation detector, arranged in the first plane, of said first unit are spaced apart essentially the same distance as the said distance between the receiving and retransmitting locations of said second unit, whereby the directions of the transmitted and the retransmitted radiations will be essentially parallel.

A particular advantage of the system according to the invention is that it can be provided with specific identification means with which it is possible, on the basis of the position information provided by the detector, to distinguish the second unit from similar units with other identification means. Such an identification means may consist of, for example, a screen which is mounted at the retransmitting location of the passive means and has a pattern specific for the second unit. The radiation detector is here adapted to sense different radiation patterns and

to provide identification information corresponding to these patterns. This possibility is of special interest in the above-mentioned application for automatically controlled trucks where each station can be provided with such identification means.

To prevent functional disorders due to dirt and the like on the radiation receiving and retransmitting surfaces in the system, the frequency of the radiation transmitted by the radiation source, and thus the radiation retransmitted by the passive means, preferably lies within the infrared range of the spectrum.

The design of the positioning system according to the invention, and its mode of application, as well as its specific application to automatically controlled trucks, will now be described in more detail below, reference being had to the accompanying drawing in which Fig. 1 is a schematic perspective view of an especially preferred embodiment of a positioning system according to the invention, Figs. 2A and 2B are lateral views of the system shown in Fig. 1 and illustrate an especially preferred mode of application thereof, and Fig. 3 is a schematic view of the application of the positioning system according to the invention to automatically controlled trucks.

Fig. 1 which illustrates the basic design of a positioning system according to the invention, shows a movable first unit 1 and a stationary second unit 2. The units 1 and 2 are arranged each in one XY plane which are mutually parallel and spaced apart in the Z direction, as indicated by the coordinate system in Fig. 1. The movement of the first unit 1 in relation to the stationary unit 2 is accomplished by control and drive means not shown. In the embodiment illustrated, it is assumed that the first unit 1 is movable in at least the X direction and the Y direction in the first plane. On its side 1a facing the second unit 2, the first unit 1 is provided with a radiation

source 3 and a radiation detector 4 spaced therefrom and sensitive to radiation of the same frequency as the radiation frequency of the source 3. Depending upon the field of application, the frequence may lie in, for example, the visible or infrared range of the spectrum.

The second unit 2 which is spaced from the first unit 1 in the Z direction, is provided on its side 2a facing the first unit 1 with a radiation receiving location 5 and a radiation retransmitting location 6 disposed at a distance A from the location 5. These locations will be referred to hereinafter as the receiving location and the retransmitting location, respectively. Furthermore, the second unit 2 is provided with a passive means 7 which, in the embodiment illustrated, is constituted by at least one U-shaped optical fibre, one end 8 of which is located at the receiving location 5, while the other end 9 is located at the retransmitting location 6. The second unit 2 is provided at its receiving location 5 with a collecting lens (not shown) or the like for directing incident radiation S1 at the receiving location 5 against the input end 8 of the optical fibre 7, and at its retransmitting location 6 with a screen (not shown) or the like, the function of which will be explained in more detail below.

As will appear from Fig. 1, the receiving location 5 and the retransmitting location 6 of the second unit 2 are spaced apart a distance A equalling the distance between the radiation source 3 and the radiation detector 4 of the first unit 1, and the optical axis of the radiation source 3 is parallel to the optical axis of the retransmitting location 6, whereby the radiation S1 transmitted by the source of radiation 3 is parallel to the radiation S2 transmitted from the retransmitting location.

The body of the second unit may be made of any suitable material, and the optical fibre 7, the collecting lens and the screen may be incorporated with said body during the production thereof, such that an integrated and robust unit is obtained.

As is shown schematically by dash lines in Fig. 1, the radiation detector 4 of the first unit 1 is extended in both the X direction and the Y direction in the first plane, and the receiving location 5 of the second unit is extended both in the X direction and in the Y direction in the second plane, for reasons that will be explained below.

The radiation detector 4 is adapted to provide position information signals when the radiation S2 retransmitted from the second unit is directed against the detection area of the detector 4.

In the preferred embodiment as herein described and shown in the drawing, the radiation detector 4 which thus has a detection area extended in the first plane, consists of a position sensitive semiconductor detector which provides electrical signals indicating where on the detection area of the radiation detector 4 the retransmitted radiation S2 impinges.

In Fig. 1, the point of incidence of the retransmitted radiation S2 is designated P.

The application of the positioning system described above with reference to Fig. 1 to position detection and position determination will now be explained in more detail, reference being had to Figs. 2A and 2B and like components being identified by like reference numerals in, respectively, Fig. 1 and Figs. 2A and 2B. For the sake simplicity, the mode of operation of the system will be explained only in that case when the first unit 1 is moving and positioned in the X direction, but it will be appreciated that the system operates in the same manner whether the movement

occurs in the Y direction or in both the X direction and the Y direction.

In a first stage, the movable unit 1 is spaced from the stationary unit 2 a distance such that the radiation S1 transmitted by the radiation source 3 is not directed against the receiving location 5 of the second unit 2. In other words, the first unit has as yet not been positioned in this stage.

In a second stage, coarse positioning of the first unit 1 relative to the second unit 2 is carried out. This coarse positioning is accomplished in that the first unit 1 is moved by means of the above-mentioned control and drive means towards the second unit 2 up to the location where the radiation S1 transmitted by the radiation source 3 impinges at the receiving location 5 of the second unit 2, passes through the collecting lens (not shown) and through the optical fibre 7, and is retransmitted (S2) towards the detection area of the detector 4. On receiving the retransmitted radiation S2, the detector 4 supplies position information which indicates that coarse positioning has been established and also where on the detection area the retransmitted radiation S2 impinges. In Fig. 2A, the "point of incidence" on the detection area is designated P1, and the position information supplied in Fig. 2A thus contains information corresponding to the point P1. In Fig. 2A, the first unit has been moved to a position which deviates by ΔX from the desired position shown in Fig. 2B.

In a third stage in which fine positioning of the first unit 1 relative to the second unit 2 is carried out, the first unit is caused, in response to the position information corresponding to the point P1, to move towards the desired position shown in Fig. 2B, i.e. to the right in Fig. 2A, by means of said control and drive means. It should here be noted that the point of incidence of the retransmitted radia-

tion S2 will lie within the detection area of the detector 4 during the entire fine positioning, and that the position information provided by the detector 4 is continuously supplied to said control and drive means during the entire fine positioning. Relative movement of the units 1 and 2 during fine positioning obviously is restricted on the one hand by the extent of the detection range in the direction of movement and, on the other hand, by the extent of the receiving location 5 of the second unit 2 in the same direction. When the first unit has been moved, by means of said control and drive means, to the position shown in Fig. 2B, in which the point of incidence of the re-transmitted radiation S2 has now been displaced from P1 to P2, the provided position information which now corresponds to the point P2, is compared with the desired position. Since the first unit 1 has now been positioned in the desired position relative to the second unit 2, the first unit is now caused to stop in the position shown in Fig. 2B.

The above-mentioned positioning process comprising a coarse positioning and a subsequent fine positioning, may be especially preferred in those cases when it is desired to move the movable unit 1 at high speed between the positions in which it is intended to stop. After coarse positioning has been accomplished (Fig. 2A), the speed can be reduced, whereupon fine positioning can be carried out at a low speed and with high accuracy.

The present invention is especially suitable for the positioning of automatically controlled trucks or the like which are controlled automatically along a path, loop or the like laid out on a factory floor. This particular use of the positioning system according to the invention will now be described in more detail, reference being had to Fig. 3 which from above and schematically illustrates an automatically controlled

truck 10 which on wheels 11 is guided along a path 12. The truck 10 is intended to stop at a plurality of stations 13 along the path 12. In order to achieve the desired positioning of the truck 10 in relation to the stations 13, the truck is provided with a first first unit 1 supporting a radiation source 3 and a radiation detector 4, the stations being provided each with one second unit 2 having a radiation receiving location 5 and a radiation retransmitting location 6. The said second, stationary and passive units 2 preferably are let into the floor, such that the upper side 2a of the units lies in the plane of the floor surface. In this application of the positioning system according to the invention, the frequency of the radiation transmitted preferably lies within the infrared range of the spectrum.

The positioning system according to the invention also offers a possibility of identifying different stations 13. Such identification can be accomplished for example by providing, at the radiation retransmitting location 6 of the station 13, a pattern specific for that station. In this instance, the radiation detector 4 on the truck 10 is adapted to detect the retransmitted radiation S2 influenced by the screen and to provide information corresponding to the specific screen pattern.

As an alternative to the screen, the passive means of the second unit 2 may consist of a plurality of optical fibres 7, the output ends 9 of which are arranged in a specific pattern at the retransmitting location 6. For detecting such a pattern a two-dimensional set of photocells may be utilised for the detector 4 on the truck 10.

The positioning of the truck 10 in relation to the respective stations 13 may be accomplished by the coarse positioning and subsequent fine positioning described above with reference to Figs. 2A and

2B. However, the positioning system according to the invention is especially applicable to the case where the truck 10 supports a robot or the like which is movable relative to the truck and adapted, when the truck 10 has been arranged in position at a station 13, to perform a movement pattern in relation to a reference system which is stationary relative to said station 13. In this case, fine positioning of the truck 10 may be omitted. More particularly, positioning can be carried out such that the truck 10 is caused to move towards a station 13 to a position in which radiation S1 transmitted by the radiation source 3 falls within the receiving location 5 of the station 13, and the retransmitted radiation S2 falls within the detection area of the detector 4. After coarse positioning of the truck 10 in this manner relative to the station 13, the truck is caused to stop, whereupon a reference system for the robot movement pattern is calculated on the basis of the position information provided by the detector 4, said reference system being dependent on the exact position of the truck 10 relative to the station 13, i.e. dependent on the point of incidence P of the retransmitted radiation S2 on the detection area of the detector 4. Thus, a complicated and time-consuming fine positioning of the truck 10 relative to the station 13 is not necessary in this case.

The invention is, of course, not restricted to the embodiment which has been described above and illustrated in the drawing and which merely constitutes an example, but may be modified in several ways within the scope of the protection claimed which is limited only by that stated in the appended claims.

For example, the two units 1 and 2 may be mounted on two objects which also are movable in the Z direction, in which case it may sometimes be interesting also to provide a positioning in the Z direction.

Such positioning can be achieved if the optical axes of the radiation source 3 and the radiation detector 4 are inclined relative to one another, for example by making the distance between the source 3 and the detector 4 greater than the distance between the receiving location 5 and the retransmitting location 6. Such a system with inclined optical axes gives a closed radiation path only if the distance in the Z direction between the first unit 1 and the second unit 2 lies within specific limits.

Finally, it should be mentioned that the passive means 7 in the second unit 2 need not consist of optical fibres; it may also be, for example, a mirror system or the like.

CLAIMS

1. A positioning system for detection and determination of a relative position between a first unit (1) arranged in a first plane and a second unit (2) arranged in a second plane parallel to said first plane and spaced therefrom, said units (1, 2) being mutually movable parallel to said planes, and said first unit (1) having a radiation source (3) for transmitting a beam of rays (S1) directed against said second unit (2), and a radiation detector (4) for detecting a beam of rays (S2) retransmitted from said second unit (2), said second unit (2) having a passive means (7) adapted, when said relative position lies within specific limits, to receive the beam of rays (S1) transmitted from said radiation source and to retransmit (S2) the radiation received towards said radiation detector (4) which is adapted, in response to the retransmitted beam of rays (S2), to provide position information corresponding to said relative position, c h a r a c t e r i s e d in that said passive means (7) has a separate radiation receiving portion (5) which is extended in said second plane and within which the transmitted beam of rays (S1) impinges when said relative position lies within said limits, and a separate radiation retransmitting portion (6) which is in optical communication with and, as seen in a direction parallel to said second plane, is spaced a distance (A) from said radiation receiving portion (5); and that said radiation detector (4) has a two-dimensionally position sensitive detection area, the beam of rays (S2) retransmitted from said radiation retransmitting portion having a convergence such that it impinges on a limited part (P) of the detection area when said relative position lies within said limits, said radiation detector being further

arranged such that the position information provided contains information about where (P) the retransmitted beam of rays (S2) impinges in the two-dimensionally extended detection area.

2. A system as claimed in claim 1, characterised in that said passive means (7) is at least one optical fibre, one end (8) of which is affixed to said radiation receiving portion (5), the other end (9) being affixed to said radiation retransmitting portion (6).

3. A system as claimed in claim 1 or 2, characterised in that said radiation detector (4) is a position sensitive semiconductor detector having a detection area continuously extended in two dimensions.

4. A system as claimed in claim 1 or 2, characterised in that said radiation detector (4) comprises a plurality of separate two-dimensionally distributed radiation sensitive elements, such as photocells.

5. A system as claimed in any one of the preceding claims, characterised in that the detection area of said radiation detector (4) is extended in parallel with said planes.

6. A system as claimed in claim 5, characterised in that the radiation source (3) and the radiation detector (4) of said first unit (1), as seen in a direction parallel to said first plane, are spaced apart a distance substantially corresponding to the said distance (A) between the radiation receiving and the radiation retransmitting portions (5, 6) of said second unit (2).

7. A system as claimed in any one of the preceding claims, characterised in that said second unit (2) has identification means which are specific for said second unit (2) and connected with the passive means (7) thereof, said identification means being

adapted to act on the received beam of radiation (S1) in such a way that the radiation detector (4), upon detection of the thus acted-upon retransmitted beam of rays (S2), can distinguish said second unit (2) from similar units (2) having other identification means.

8. A system as claimed in claim 7, characterised in that said identification means is a screen mounted on the radiation retransmitting portion (6) of said passive means (7), said screen having a pattern specific for said second unit (2).

9. A system as claimed in any one of the preceding claims, characterised in that the frequency of the beam of rays transmitted (S1) by said radiation source (3) and retransmitted (S2) by said passive means (7) lies within the infrared range of the spectrum.

10. A system as claimed in any one of the preceding claims, characterised in that the system has means adapted to receive the position information provided by said radiation detector (4) when said relative position lies within said limits, and to act upon at least one of said units in response to the position information received, such that a desired relative position within the said limits is obtained.

11. A system as claimed in any one of the preceding claims, comprising a robot or the like mounted on said first or said second unit (1 and 2, respectively) and movable relative to this unit, characterised in that said system has means adapted to receive the position information provided by said radiation detector (4) when said relative position lies within said limits, to stop the relative movements of said units (1, 2) in response to the position information received, and to calculate, on the basis of the position information received, a reference system for the robot movements.

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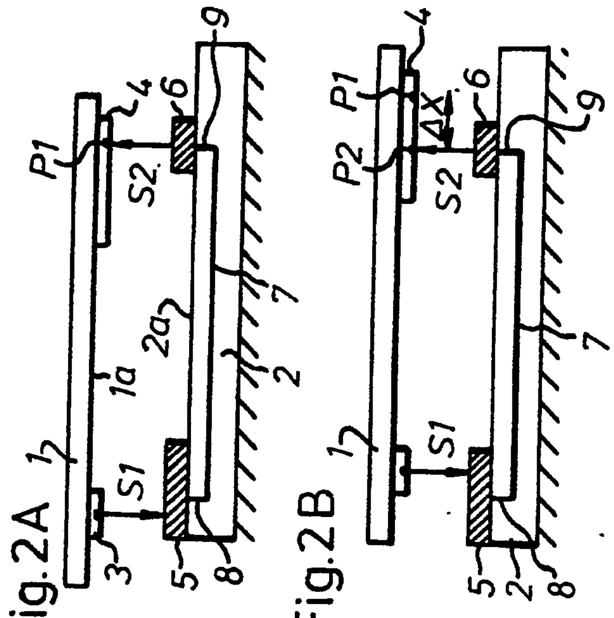

Fig.2A

Fig.2B

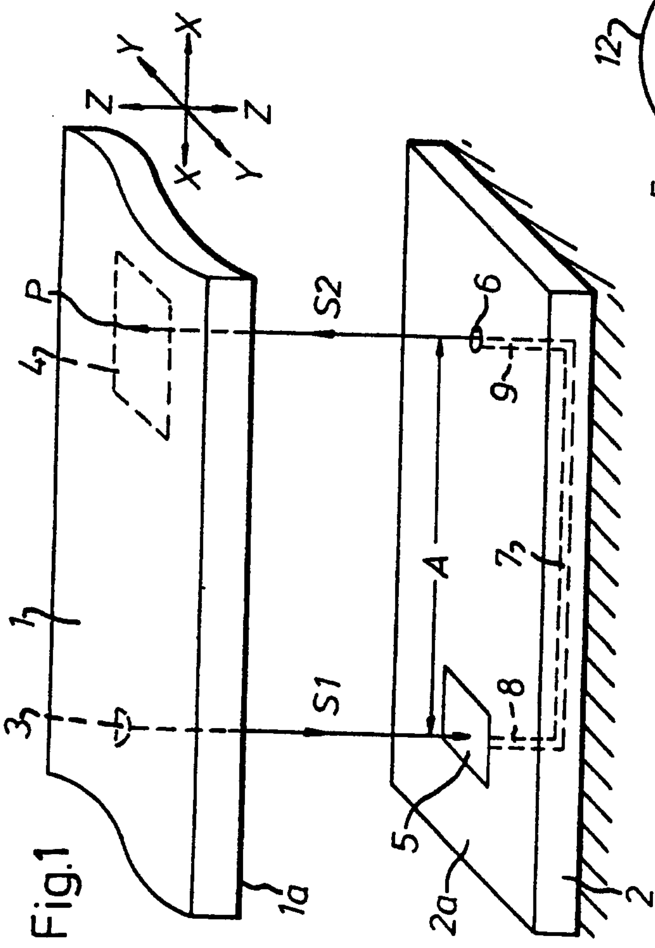

Fig.1

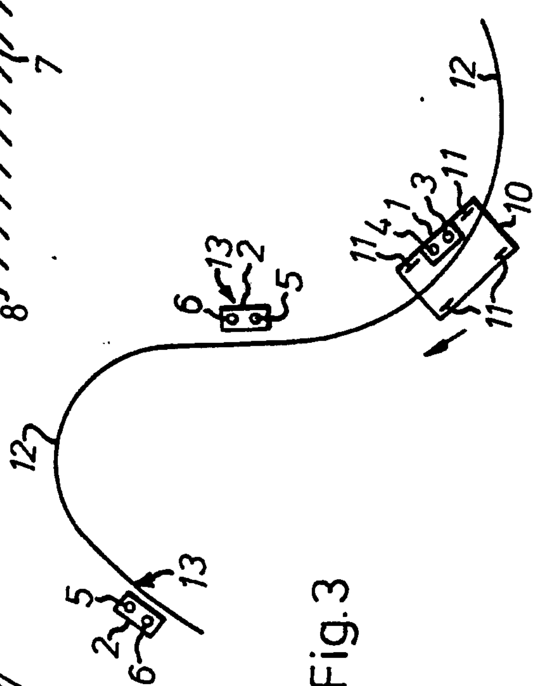

Fig.3

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE86/00184

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [8]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

G 01 S 17/74, G 05 D 1/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	G 01 S 9/62, 17/00-/06, /42, /46, /74, /88; G 05 D 1/00-/03
US Cl	180:79.1, 98; 343:7; 356:152, 400

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [*]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	DE, A1, 2 617 797 (W. SCHULTZ) 3 November 1977 See figure 5	
A	SE, B, 366 127 (ALLMÄNNA SVENSKA ELEKTRISKA AB) 8 April 1974	
A	DE, A1, 3 320 163 (PRÜFTECHNIK DIETER BUSCH +PARTNER GMBH & CO) 13 December 1984	
A	Derwent's Abstract No. J 7481 K/26, SU 953457	

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1986-06-25	1986 -06- 30
International Searching Authority	**Signature of Authorized Officer**
Swedish Patent Office	Göran Magnusson Göran Magnusson

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